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POTTING MEDIA FOR *ATRIPLEX* PRODUCTION UNDER GREENHOUSE CONDITIONS

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ABSTRACT

*A potting medium composed of 50 percent sphagnum moss peat, 30 percent arcillite aggregate, and 20 percent vermiculite is recommended for growing Bonneville saltbush (*Atriplex bonnevillensis Hanson*) in containers. This medium may be satisfactory for other plant species native to alkaline soils of semiarid areas. Of 39 potting media evaluated, no single formulation was clearly superior. Media containing sphagnum moss peat, vermiculite, and arcillite, however, were judged more suitable from the standpoint of plant yield and water retention than media composed of sphagnum moss peat, vermiciulite, and perlite. Although some soil-amended media produced slightly larger seedlings than soilless media, the decreased seedling emergence and greater mortality from damping-off in the former made soilless media preferable.*

KEYWORDS: container-grown plants, potting media, *Atriplex bonnevillensis.*

Many plants native to semiarid lands of the Great Basin and Colorado Plateaus are useful in the reclamation of surface-mined areas. Shrub species will play an important part in such reclamation. In semiarid areas, transplanting container-grown planting stock is often more successful than establishing shrubs by direct seeding (Frischknecht and Ferguson 1979).

As the demand for planting stock of native shrubs increases, plant propagators will need to know the best ways to grow high-quality plants for transplanting.

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Potting media composed of sphagnum moss peat and vermiculite are commonly used for growing containerized plants (Boodley and Sheldrake 1967, 1973; Phipps 1974; Cayford 1972; and Owston 1972). Perlite is sometimes used with moss peat instead of vermiculite. Many growers continue to use growing media having a large proportion of soil or sand (Augustine and others 1979). The great weight of soil or sand, however, adds to the expense of handling in the greenhouse, shipping to the field planting site, and in planting operations.

This study was designed to learn more about potting media useful for growing Bonneville saltbush (*Atriplex bonnevillensis*), which is one of the more promising native North American species of *Atriplex* for reclaiming surface-mined land (Frischknecht and Ferguson 1979).

EXPERIMENTAL METHODS

The potting media evaluated in this study were composed of various combinations of Canadian sphagnum moss peat, horticultural grade vermiculite, horticultural grade perlite, arcillite aggregate, and nonpasteurized topsoil from a salt desert shrub community in central Utah (table 1).

Arcillite is a montmorillonite clay that is calcined to stabilize the aggregate. The brand used in this

Table 1.—Number of Bonneville saltbush seedlings emerging, percent mortality from damping-off, and mean ovendry weight of plant tops, for 19 potting media with and without soil, and for soil alone

Mix number	Composition[1] SMP/V/P/A	Number of seedlings emerging	Percent damping-off	Mean ovendry weight[3]
	Percent			*Grams*
1	67/33/0/0	158 (59)[2]	1 (20)	0.36 (0.50)
2	67/0/33/0	162 (51)	2 (26)	.21 (.40)
3	67/0/0/33	183 (109)	2 (17)	.32 (.32)
4	60/20/20/0	116 (94)	3 (8)	.32 (.34)
5	60/20/0/20	163 (114)	1 (12)	.28 (.34)
6	50/50/0/0	140 (111)	2 (4)	.34 (.34)
7	50/20/30/0	168 (79)	1 (18)	.26 (.28)
8	50/20/0/30	195 (177)	5 (6)	.40 (.50)
9	40/40/20/0	164 (60)	4 (17)	.26 (.34)
10	40/40/0/20	224 (103)	2 (29)	.40 (.52)
11	35/35/30/0	244 (47)	1 (11)	.32 (.36)
12	35/35/0/30	286 (248)	5 (12)	.40 (.36)
13	33/67/0/0	229 (150)	12 (25)	.30 (.29)
14	20/60/20/0	364 (119)	5 (31)	.24 (.38)
15	20/60/0/20	347 (246)	9 (14)	.37 (.34)
16	20/50/30/0	257 (94)	3 (22)	.33 (.35)
17	20/50/0/30	421 (176)	4 (26)	.31 (.43)
18	0/67/33/0	215 (375)	3 (7)	.25 (.23)
19	0/67/0/33	439 (213)	7 (32)	.30 (.32)
Soil	0/0/0/0	139 —	19 —	.19 —

[1] Sphagnum moss peat (SMP), vermiculite (V), perlite (P), arcillite (A).

[2] Figures in parentheses are for same mixture composition plus 5 percent by volume of soil.

[3] Mean ovendry weight of aerial part of 20 plants harvested after 4½ months.

study was Turface, a product of Wyandotte Chemicals Corporation, Wyandotte, Mich.[2] Percent of the aggregates passing through 8-, 2-, 1-, and 0.5-mm sieves equalled 100, 78, 31, and 10, respectively.

Nineteen different media of two or more of the above soilless ingredients were compared with the same 19 media amended with an additional 5 percent, by volume, of topsoil. The small amount of topsoil was added to determine whether seedling growth would be increased without adding appreciably to the weight of the potting medium. Topsoil alone was also included in the experiment.

Potting medium ingredients were mixed thoroughly by hand and dampened to a consistency suitable for filling the containers. All media except the topsoil were supplemented with the following amounts of nutrient amendments per cubic foot (28.3 liter) of medium: agricultural lime, 200 g; calcium nitrate, 27 g; gypsum, 84 g; treble superphosphate, 21 g; Osmocote (18-6-12), 36 g; fritted trace elements (FTE #503), 3.2 g; chelated iron, 1 g; and surfactant (Triton N-101),[2] 2 g.

The experimental design consisted of 39 treatments (media) each with two replications. Seventy-eight trays of seedlings (two per treatment) were arranged completely at random on one greenhouse bench. Seedlings were grown in Spencer-Lemaire Rootrainers (Five-type).[2] This type of plastic container has five cavities, each with a volume of 60 cc, and dimensions of 1 inch X 1 inch X 4½ inches (2.54 cm X 2.54 cm X 11.4 cm). Thirteen containers are held in each tray, making a total of 65 cavities per tray.

Six Bonneville saltbush seeds were sown in each container cavity in mid-November. Seeded trays were arranged in random sequence on the greenhouse bench and their positions rotated at 2-week intervals during the study.

Seedlings were grown for a 4½-month period. No additional fertilizer was provided during the study period. Plants were watered as needed with tapwater having a pH of 7.3. Day length was extended to 16 hours with "Grolux" fluorescent lighting.[2]

Data on seedling emergence were recorded 17 days following seeding. Data on mortality caused by damping-off were recorded at 17 days and 31 days following seeding. Seedlings were thinned to one per container cavity 31 days following seeding. At the end of the study period, 20 seedlings were harvested from each tray and mean oven-dry weight determined.

Water absorption and retention capacity of media was determined by periodic weighing following saturation. This phase of the study was done independently of the greenhouse phase. Media were packed in Five-type Rootrainers[2] in the same manner used when growing the saltbush seedlings. Containers were kept in the laboratory at room temperatures for a 7-week period.

RESULTS

Seedling emergence and early mortality.—Soilless potting media produced an average of over twice as many (109 percent) emergent seedlings as media containing 5 percent topsoil. In soilless media, as the ratio of moss peat to vermiculite decreased, the number of emergent seedlings increased (table 1). In media containing topsoil, however, seedling emergence did not appear to be related to the moss peat/vermiculite ratio. In both soilless and soil-amended media, seedling emergence tended to be greater when the medium was composed of moss peat, vermiculite, and arcillite compared to moss peat, vermiculite, and perlite.

Mortality of emergent seedlings caused by damping-off fungi was much greater in the media with soil than in soilless media (table 1). Mortality in the 19 soil-amended media averaged 18 percent (range = 4 to 32 percent); the average mortality for the 19 soilless media was 4 percent (range=<1 to 12 percent). Seedling mortality from damping-off was 19 percent in a growing medium of 100 percent topsoil.

In the four media that contained no moss peat, many seedlings emerged with the cotyledons still bound in the husk of the utricle; so the hypocotyl did not penetrate the potting medium well. Some of these seedlings eventually died. Seedlings emerged normally in all other media.

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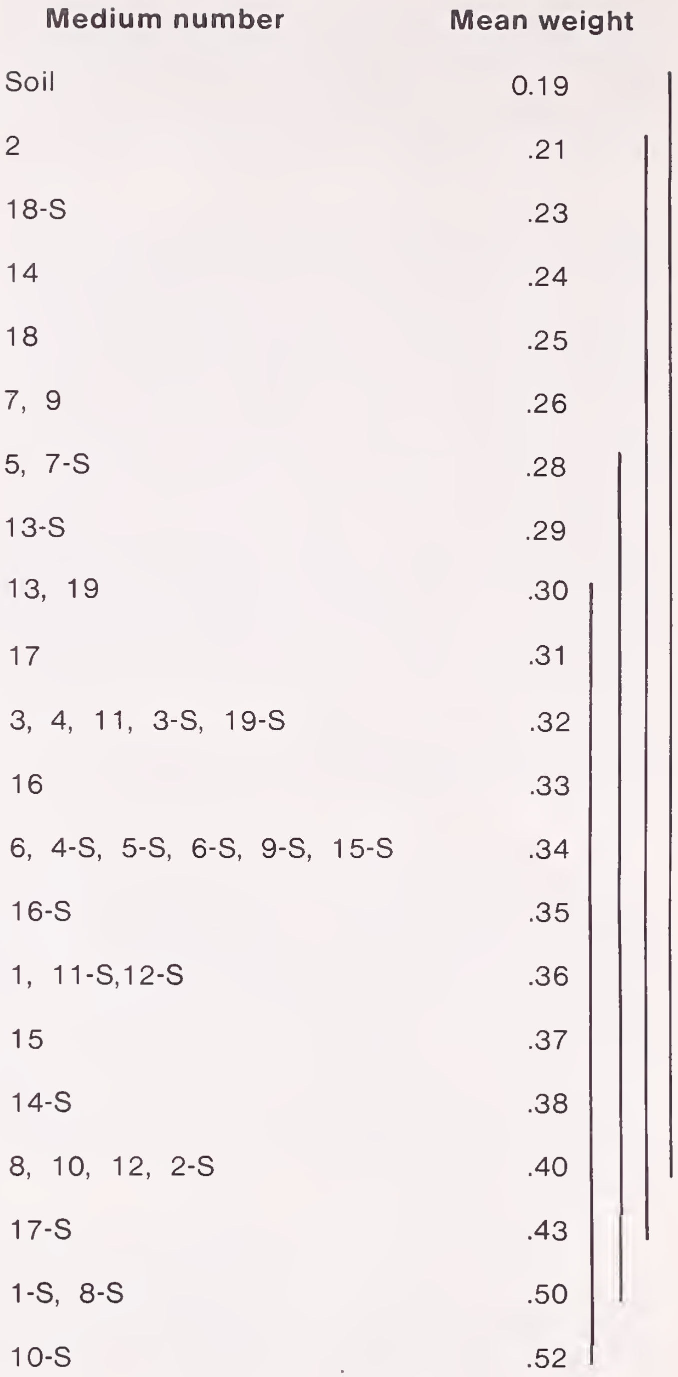
[2] The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.

Seedling growth.—Ovendry weight of the aerial portion of the seedlings was obtained after a 4½-month growing period. Analysis of variance indicated a highly significant difference ($p = <0.01$) in weight among media. Keul's multiple range test (Snedecor 1956) was used to separate significantly different means (fig. 1, $p =<0.05$). Media No. 8, No. 10, and No. 12, with and without topsoil, were all above average in terms of plant weight. Seven of the top 10 mean plant weights were produced by media containing arcillite (table 1). Six of the top 10 mean plant weights were produced by media amended with topsoil. Topsoil may have added some plant nutrients, may have introduced beneficial mycorrhizae, or increased cation exchange capacity of these media.

The five highest mean plant weights among the soilless media (No. 8, No. 10, No. 12, No. 15, and No. 1) were all produced by media that had a pH between 6.0 and 6.5 and an EC_e between 1.9 and 4.6 mmhos/cm at the end of the experiment. The remaining 14 soilless media exhibited either a pH or EC_e outside this range. Among media amended with soil, plant weight, as measured at the end of the experiment, was not consistently related to either pH or EC_e.

Water absorption and retention.—When at container capacity, the various test media absorbed from 30 to 220 percent more water than did the topsoil alone (table 2). Moss peat is the primary water-absorbing component in such mixtures. As the proportion of moss peat in the mixtures decreased, the total amount of water held (and retained with the passage of time) generally decreased. When the percentage of moss peat in the mixture was less than 40, the combination of moss peat, vermiculite, and arcillite tended to retain more water against the forces of evaporation than the combination of moss peat, vermiculite, and perlite (table 2).



Medium number	Mean weight
Soil	0.19
2	.21
18-S	.23
14	.24
18	.25
7, 9	.26
5, 7-S	.28
13-S	.29
13, 19	.30
17	.31
3, 4, 11, 3-S, 19-S	.32
16	.33
6, 4-S, 5-S, 6-S, 9-S, 15-S	.34
16-S	.35
1, 11-S, 12-S	.36
15	.37
14-S	.38
8, 10, 12, 2-S	.40
17-S	.43
1-S, 8-S	.50
10-S	.52

Figure 1.—Mean ovendry weight, in grams, of Bonneville saltbush seedling tops grown in 19 different potting media with and without soil and in soil alone. Any two means paralleled by the same line are not significantly different (α p = 0.05).

Media No. 5 through No. 10 (except No. 7) were superior to other media in long-term water retention. Media No. 6, No. 8, and No. 10 were most resistive to evaporative water loss. Two of these media contained arcillite, which holds water by both absorption and adsorption because of the capillaries in each particle. This characteristic of arcillite would be of increasing value with respect to water retention capacity as the height of the container increased. As noted by Van Bavel and others (1978), the average water content of a container of soil or similar material decreases with increasing container height once drainage ceases. The relative ability of a potting medium to resist water loss to physical forces may be important should a dry period follow planting.

Table 2.—Water retention characteristics of 19 potting media with and without soil and of soil alone

Mix number	Composition[1] SMP/V/P/A	Relative weight at container capacity	Volume percent[2]	Percent of water retained[3]	
				After 1 week	After 7 weeks
	Percent				
1	67/33/0/0	[4]1.4 (1.6)	73 (81)	74 (76)	2 (7)
2	67/0/33/0	1.3 (1.5)	72 (70)	76 (75)	5 (7)
3	67/0/0/33	1.7 (1.8)	74 (74)	75 (79)	9 (12)
4	60/20/20/0	1.4 (1.5)	75 (67)	82 (77)	16 (14)
5	60/20/0/20	1.6 (1.7)	69 (72)	77 (80)	15 (18)
6	50/50/0/0	1.5 (1.6)	78 (78)	78 (81)	18 (20)
7	50/20/30/0	1.3 (1.5)	69 (71)	76 (75)	11 (14)
8	50/20/0/30	1.8 (1.9)	76 (74)	79 (80)	19 (20)
9	40/40/20/0	1.5 (1.5)	76 (71)	77 (78)	17 (16)
10	40/40/0/20	1.6 (1.8)	68 (68)	79 (79)	19 (16)
11	35/35/30/0	1.3 (1.5)	63 (66)	73 (73)	14 (13)
12	35/35/0/30	1.7 (1.8)	67 (68)	74 (75)	15 (13)
13	33/67/0/0	1.5 (1.6)	76 (74)	74 (73)	12 (9)
14	20/60/20/0	1.2 (1.4)	60 (62)	64 (68)	3 (5)
15	20/60/0/20	1.4 (1.7)	63 (68)	73 (75)	10 (12)
16	20/50/30/0	1.1 (1.3)	54 (61)	70 (70)	12 (11)
17	20/50/0/30	1.5 (1.8)	64 (69)	76 (74)	15 (11)
18	0/67/33/0	1.0 (1.3)	47 (58)	70 (72)	9 (7)
19	0/67/0/33	1.5 (1.6)	62 (61)	80 (77)	18 (15)
Soil	0/0/0/0	2.7 —	36 —	68 —	10 —

[1] Sphagnum moss peat (SMP), vermiculite (V), perlite (P), arcillite (A).

[2] Percent of the volume of the container occupied by water 24 hours after saturation to container capacity.

[3] Based on container capacity being equal to 100 percent.

[4] Figures in parentheses are for same mixture composition plus 5 percent by volume of soil.

Hydrogen ion concentration and electrical conductivity.—Both pH and electrical conductivity of the saturation extract (EC_e) of all potting media were measured at the beginning and end of the experiment (table 3).

All media, except No. 8, No. 10, No. 12, No. 15, No. 17, No. 12-S, and No. 18-S, showed an increase in pH during the study period. Except for No. 18-S, these media contained 50 percent or less moss peat plus vermiculite, and arcillite. While media with arcillite tended to have higher pH values than media without arcillite at the beginning of the study, the buffering property of arcillite prevented subsequent increases in pH.

Table 3.—Hydrogen ion concentration and electrical conductivity of saturation extracts of 19 potting media with and without soil, and of soil alone, at the beginning and end of a 4½-month growing period

Mix number	Composition[1] SMP/V/P/A	pH of saturation extract		EC_e of saturation extract	
		Initial	Final	Initial	Final
	Percent			*mmhos/cm*	
1	67/33/0/0	[2]6.0 (6.6)	6.9 (7.5)	1.3 (1.5)	2.0 (0.9)
2	67/0/33/0	6.0 (6.4)	6.8 (7.4)	.7 (.9)	1.6 (2.5)
3	67/0/0/33	6.4 (7.1)	7.1 (7.7)	1.0 (.7)	1.8 (.6)
4	60/20/20/0	5.4 (6.4)	6.8 (7.3)	3.6 (.9)	1.2 (1.2)
5	60/20/0/20	6.4 (6.8)	7.2 (7.5)	.8 (.9)	1.4 (1.8)
6	50/50/0/0	5.7 (6.4)	7.3 (7.5)	2.8 (.8)	1.5 (1.5)
7	50/20/30/0	5.6 (6.4)	7.2 (7.5)	3.4 (.9)	1.0 (1.2)
8	50/20/0/30	6.2 (6.8)	6.0 (7.2)	2.9 (.9)	4.3 (3.5)
9	40/40/20/0	6.4 (6.9)	7.7 (7.6)	.8 (.4)	.6 (1.1)
10	40/40/0/20	6.4 (6.9)	6.0 (7.4)	1.6 (.9)	3.4 (1.2)
11	35/35/30/0	6.4 (6.7)	7.4 (7.7)	.8 (.6)	.9 (.9)
12	35/35/0/30	6.5 (6.9)	6.1 (6.7)	2.7 (1.5)	1.9 (8.4)
13	33/67/0/0	5.9 (7.0)	7.2 (7.8)	1.5 (.6)	1.0 (1.4)
14	20/60/20/0	6.0 (7.0)	7.6 (7.9)	3.4 (.7)	.9 (1.4)
15	20/60/0/20	6.5 (7.0)	6.5 (7.4)	2.2 (.9)	4.6 (4.0)
16	20/50/30/0	6.3 (6.9)	7.7 (7.7)	.9 (.7)	1.2 (1.1)
17	20/50/0/30	6.5 (7.4)	6.4 (7.5)	2.8 (1.5)	8.1 (3.3)
18	0/67/33/0	7.3 (7.8)	7.4 (7.5)	1.1 (.4)	3.0 (2.0)
19	0/67/0/33	7.4 (7.4)	7.5 (7.6)	1.0 (.9)	1.7 (1.7)
Soil	0/0/0/0	9.1 —	8.1 —	.2 —	5.1 —

[1] Sphagnum moss peat (SMP), vermiculite (V), perlite (P), arcillite (A).

[2] Figures in parentheses are for the same mixture composition plus 5 percent by volume of soil.

CONCLUSIONS

Bonneville saltbush attained greater size in soilless media containing arcillite than in media without it. When 5 percent, by volume, of topsoil (pH = 9.1) was added to the same series of media, three of the five media yielding the heaviest plants contained arcillite. Our study has shown that the inclusion of arcillite in a medium of fertilized moss peat and vermiculite tends to stabilize pH of the media. Measurements of the electrical conductivity of the saturation extract showed that media with arcillite also exhibited greater salinity than did media without arcillite.

Although some potting media containing 5 percent soil produced slightly larger seedlings than did soilless media, the decreased seedling emergence and greater mortality from damping-off in soil-amended media make soilless media preferable.

Field planting of container-grown planting stock requires that the root system of the plant form a cohesive plug which can be removed from the container with minimal disturbance to the roots. For this reason, potting media should contain a minimum of 40 percent moss peat. Potting media consisting primarily of vermiculite, such as No. 13 through No. 19 used in this study, tend to fall apart when the plug is removed from the container.

For Bonneville saltbush, a medium of 50 percent moss peat, 30 percent arcillite aggregate, and 20 percent vermiculite is a useful basic growing medium. Such a medium may be satisfactory for other plant species native to alkaline soils of semiarid areas.

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